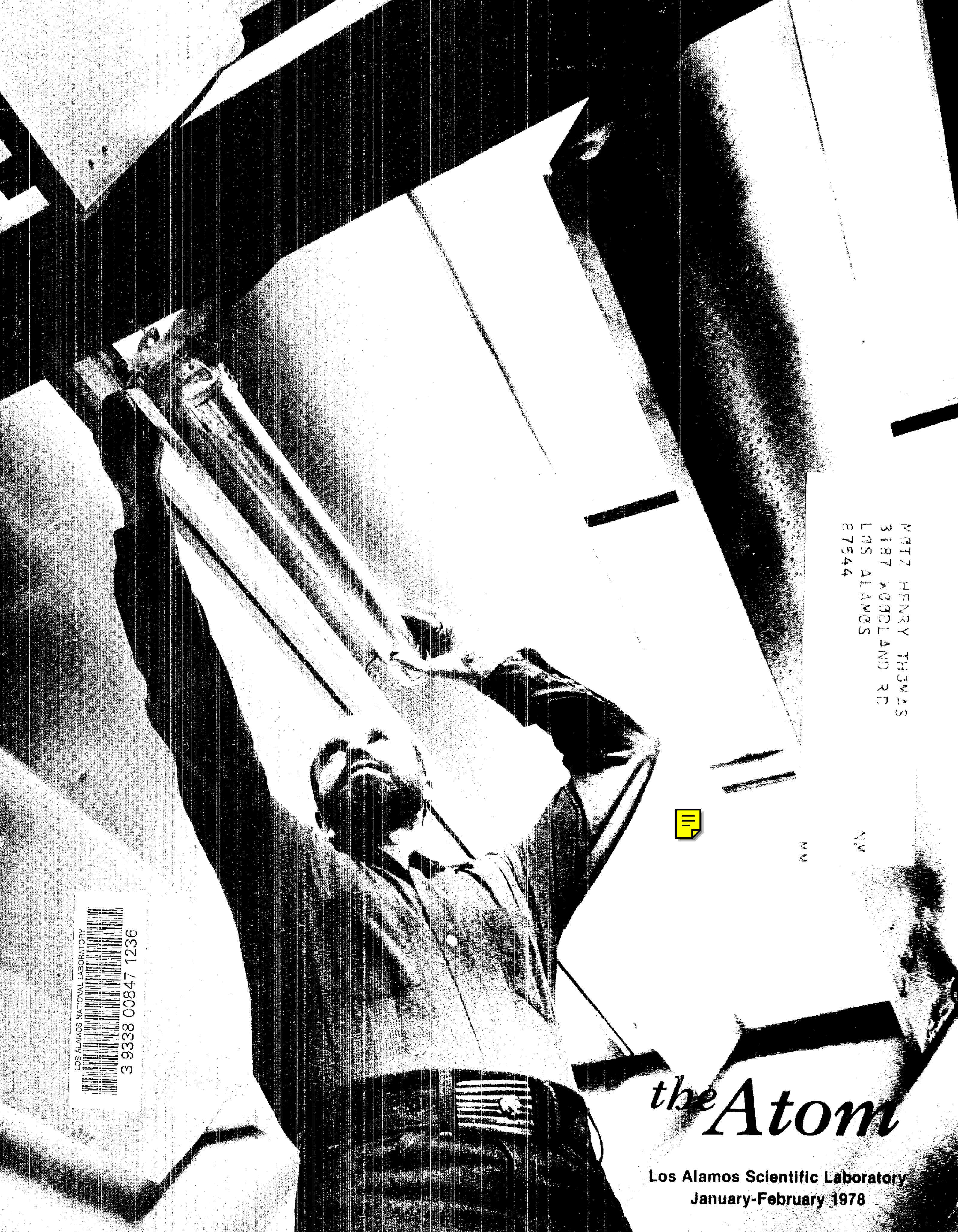

the Atom

Los Alamos Scientific Laboratory

January-February 1978

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In this Issue

Regular Features

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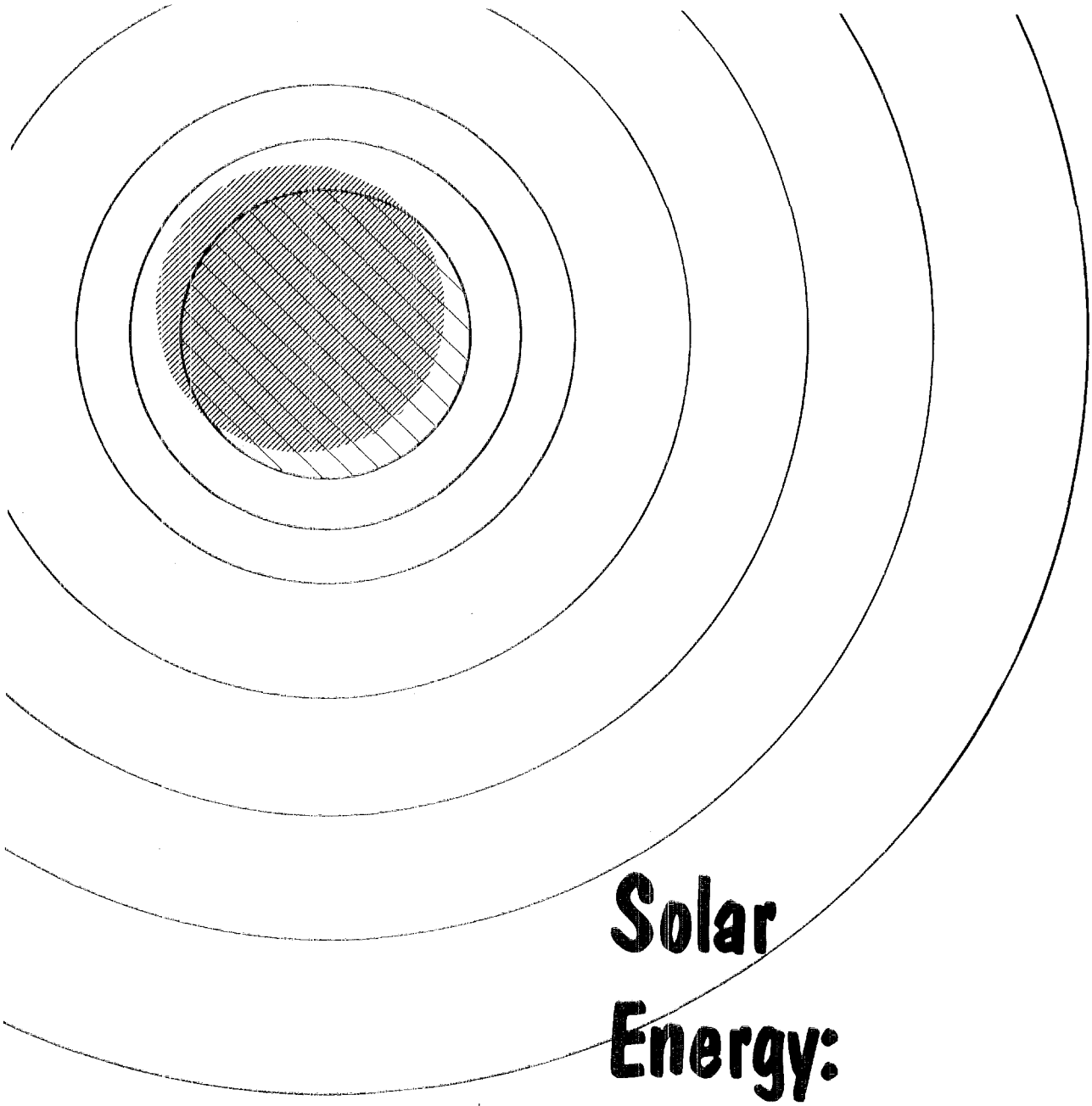
FRONT COVER

Carl Newton adjusts the "Skylid" roof in the central greenhouse of his White Rock home. Each metal panel has a black canister, facing the sky, and a light canister, facing inside. Freon flows through tubing from the black canister, when the sun's heat forces the liquid to the inside canister, where it condenses. The shift in weight causes the Skylids, which are mounted on ball-bearing pivots, to open. At night, the black canisters radiate much of their heat outward and cool down. The Freon medium shifts again and the Skylids close, preventing a great deal of heat loss. Adobe walls and window openings transfer the sun's stored heat to other living quarters throughout the evening. The photo is by Johnnie Martinez.



Solar Energy:

Abundant But Not Free

LASL Studies Solar Energy Systems

By Jeff Pederson

Solar energy may be abundant and clean, but it is not free.

A building will cost more with solar heating or cooling "add-ons," and manufacturers are not yet crowding onto the sunlight bandwagon. And the sun, unlike "active" solar panels and conventional fossil-fueled furnaces, cannot be controlled with the turn of a thermostat dial.

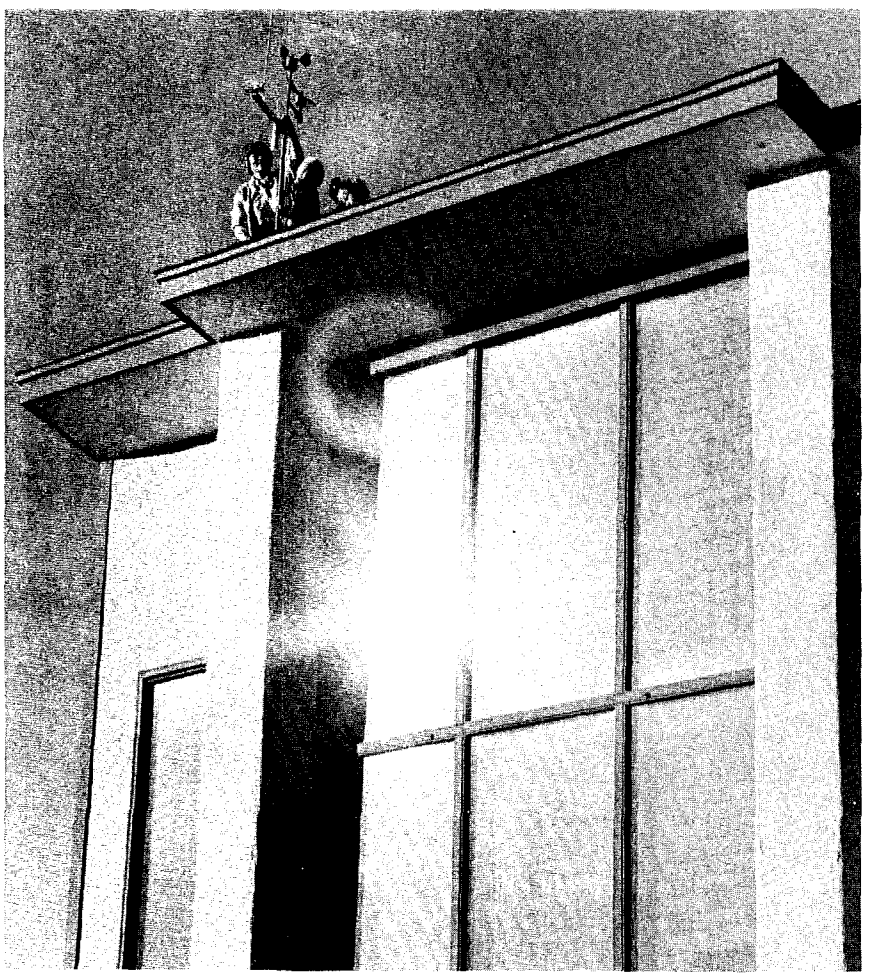
Yet people for thousands of years — notably the southwest Indians — used solar heat. And the modern-day interest is on the upswing: The U.S. Department of Energy is spending $360 million this fiscal year on solar-related projects. Of this, $1.6 million is earmarked for LASL efforts, a big increase from the $130,000 of FY 1973. In light of projections that America will reach its peak use of petroleum products within the present generation, LASL's research efforts in solar collector design, passive solar systems research, and technical monitoring are timely indeed.

No consensus has yet been offered on how best to harness Old Man Sol, whose heat may vary 50 degrees or more during the course of a day. "Rules of thumb," however, are emerging from data collected and analyzed under the direction of J. Douglas Balcomb, assistant Energy (Q) Division leader for solar energy, and Charles Bankston, Solar Energy group (Q-11) leader.

"Passive systems are very important, and they have not gotten the attention they deserve," says Balcomb. "Passive solar heating systems can be effective in all U.S. climate zones, and are usually maintenance-free. And like other building innovations throughout history, solar systems can be expected to permeate from the more expensive homes down. They will become less expensive in time, as they become more widespread in use."

A passive system, where heat flows by natural means without external energy, does not rely on solar collector plates or electric blowers. Balcomb feels passive designs, long misunderstood for lack of quantitative data, are coming into their own. He is joined in his sentiments by many people who now live in sun-tempered homes.

"LASL monitoring has shown us what really happens with our house temperatures," says Mrs. Bruce Hunn of the mass-wall residence she and her husband designed in White Rock. "Passive is the only way to go. You don't have to have the system clicking and whirling. Our previous home was a third smaller, and took twice the natural gas to heat." The 2,000-square-foot structure features a 2-story masonry wall, facing south, which supplies 60 to 70 per cent of the home's heat. The solar add-on cost



The Bruce Hunn home in White Rock features a dramatic 2-story Trombe-wall and claims a 60 to 70 per cent solar heating fraction. The family, including Mrs. Hunn, Susanne, and Michael, shown on the roof, says LASL monitoring has shown them what really happens with passive heat.

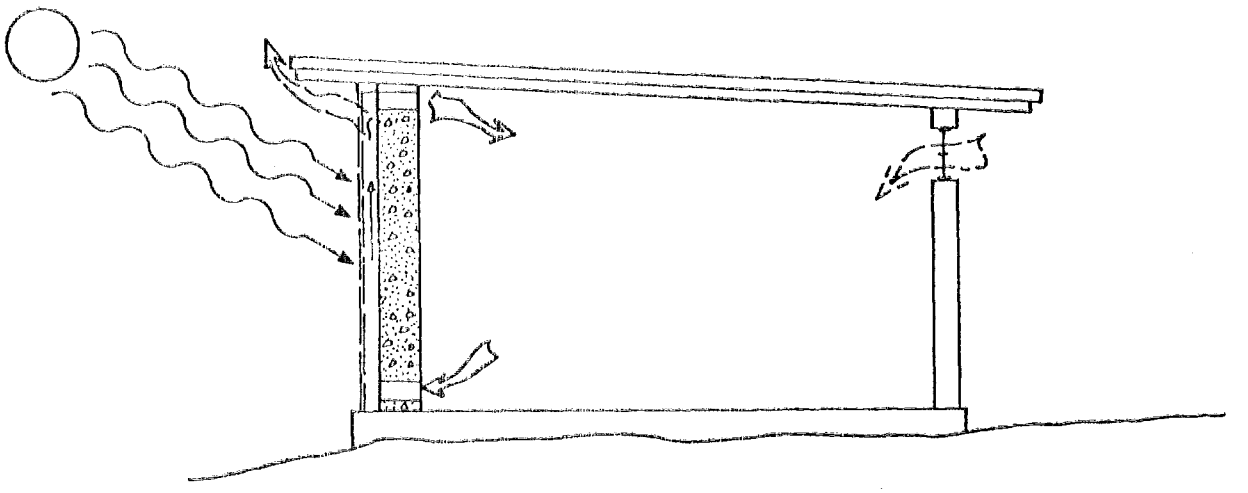
was 10 per cent of the construction total. Almost all of the heat comes to the living area from the foot-thick wall (300 square feet) and not from the 11 tons of rock in an underground storage bin, LASL instrumentation has shown. The Hunns now plan to add a greenhouse to the west wing, which does not benefit directly from the strikingly designed Trombe-wall. The house is spacious, modern, and comfortable.

The Carl Newton house in White Rock also gains 60 to 70 per cent of its heating requirements from the sun, drawing energy through a 400-square-foot central greenhouse and channeling it through another 2,700 square feet of living space. "Our object is 100 per cent solar," says Newton, who has incorporated a "Skylid" system on the greenhouse roof's interior. Metal panels open with daylight and close at night on a gravity system operated by the flow of Freon, which responds to the sun's heat phases. Orchids enjoy the heat and humidity; warmth radiates through adobe walls and through door and window openings into other rooms. The family has 3 water-filled drums hidden in each of 2 adobe bench (banco) walls for extra heat storage and plans no auxiliary heat, other than fireplaces. Like the Hunn house, the Newton residence had thermocouples and wiring built into its fabric during construction so LASL could easily obtain temperature data. Heat is also gained directly through clerestory windows.

A warehouse and office building in Pecos, New Mexico, belonging to the Benedictine Monastery, is another of the 15 structures being closely monitored by the LASL solar group. About 95 per cent of the heat needed for its 8,000 square feet of floor space comes from the sun's energy, much of which is stored in a double row of 55-gallon drums filled with water. Last winter, the monastery spent just $80 for electric backup heat.

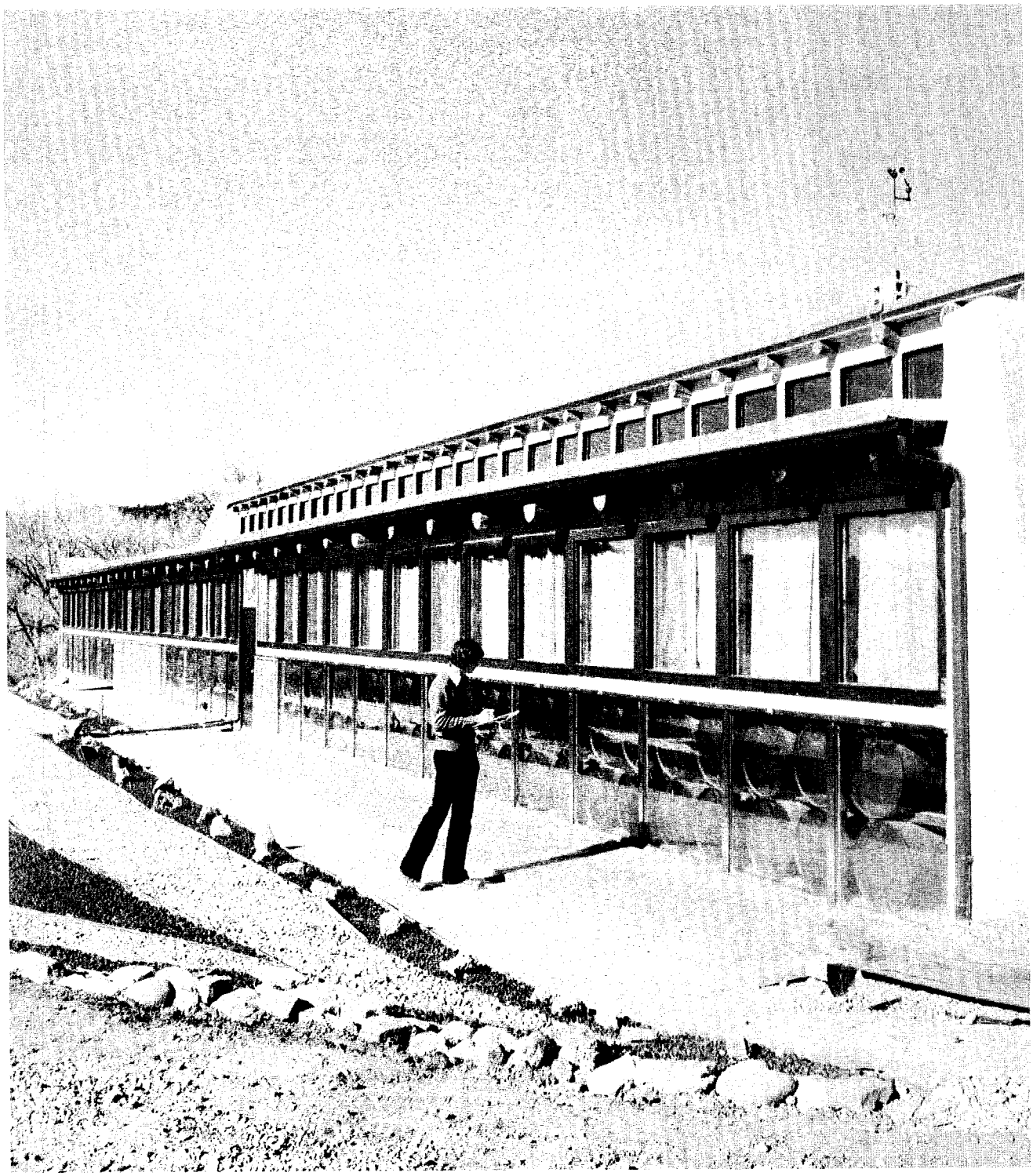
The thermocouples in the monitored buildings generate small voltages that change as the temperature changes. The temperature is plotted onto graph paper by chart recording units. Half of the multipoint chart recorders are now being replaced by digital cassette units, which will interface more conveniently with LASL computers. The information can be transferred from cassette to a memory bank or onto paper, and analysis will become both easier and quicker, according to Bankston.

LASL's ultramodern National Security and Resources Study Center, by comparison, has its own complex evaluation system and draws 94 per cent of its heating needs — along with 70 per cent of its cooling — from 8,000 square feet of flat-plate, liquid-heating solar collectors. The cost of the structure, which comprises 60,000 square feet, was increased less than 10 per cent by the cost of solar add-ons. Two cooling systems are being monitored side by side to compare



TROMBE HOUSE

In a Trombe design, sunshine passes through glazing and into a thermal mass wall where outer temperatures can reach 160 degrees F. The stored energy is radiated into the living area over a period of several hours, and a ventilation system prevents overheating during warm seasons.



The monastery warehouse at Pecos gains 95 per cent of its heating needs from the sun, and stores energy in a double row of 55 gallon drums. Solar group member Mike Ulibarry checks the aluminum reflector system on the sidewalk; clerestory windows atop the building give direct gain heating to the storage area in the rear. LASL thermocouples are wired into the drumwall and into meteorological instruments on the roof. The 8,000-square-foot structure required $80 worth of supplemental heat last year.

their performances. Balcomb thinks the Study Center's overall efficiency can even be improved 10 or 15 per cent with better control techniques.

"Living in a passive solar building is a little like going sailing," he says. "You can trim the craft to adjust for changes in weather." Balcomb's own 2,300-square-foot Santa Fe home features a 400-square-foot solar greenhouse. Thermal walls keep high afternoon temperatures out of the living area and pass on the stored heat over a period of many hours. One of his neighbors, Dave Gunderson, has a large crescent-shaped home with a Trombe thermal wall at each end. Both are custom homes in which solar add-on is about 10 per cent of the total cost.

"It won't stay expensive," Balcomb predicts. "In Denver, for instance, a builder constructed a 45-home project with help from the government Solar Demonstration Program. Thirty homes were fitted with solar systems, and the others could be retrofitted easily. Imagine the talk over the backyard fence — 'What was your utility bill last month?' "

There are 5 basic passive solar design techniques. In a direct-gain home, an expanse of glass — normally double-pane — faces south. A thermal mass, in the form of heavy walls and floors, stores the heat and turns the building into a live-in collector. In the 2-story Wallasey School, built in 1962 in Liverpool, England, no extra heat has been needed. The south wall of glass is 27 by 230 feet and the concrete walls, floor, and roof store heat. The supplemental warmth comes from lighting and the gathered bodies of students. One direct-gain home, owned by Ralph Williamson in Santa Fe, is being monitored by LASL.

In the thermal-storage wall, often called a Trombe design after a house built by Felix Trombe in 1967 in Odeillo, France, the sun's energy is absorbed by masonry or water drums located just behind the south glass. Heat is transmitted over several hours to the living quarters. The addition of vents in the wall causes a thermocirculation path along which heat moves by natural convection, as in the Pecos monastery. Wall temperatures can reach 160 degrees on the outside surface, but inside surface temperatures are moderate.

A solar greenhouse mixes these 2 concepts, and can supply extra humidity and even part of the family food needs. A thermal wall, such as in the Newton and Balcomb homes, acts as a buffer to protect the living areas from temperature variations and also transmits stored heat — often being most effective at 8 or 10 p.m.

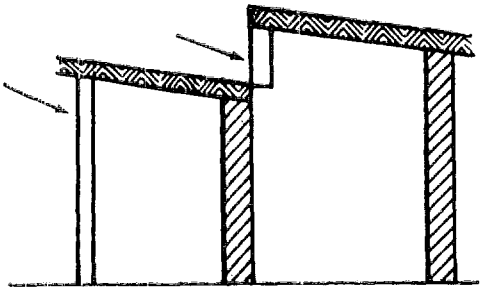
A roof pond system, in use at LASL's second experimental modular unit at the Solar Lab (TA-46), features storage in overhead liquid-filled plastic bags. Movable insulation is needed to prevent night heat loss, and the system can act to provide cooling in the summer. The Harold Hay "Skytherm" house in Atascadero, California, provides all the heating and cooling through the year despite outside temperatures which range from 10 to 110 degrees F. The LASL design, however, is quite different than the Skytherm approach since it is primarily for cold-climate heating.

The fifth type is a natural convective loop, such as the Paul Davis house in Corrales, New Mexico. Air becomes the heat transport fluid as it rises, through buoyancy, and moves from a collector region to a higher storage unit. Heat is extended from rock beds or water drums to warm the living space. LASL will be monitoring a similar home being built by Mark Jones in Santa Fe.

These solar types, and variations on these themes, are under study at the Solar Lab on Pajarito Road. Fourteen test rooms are the experimental outgrowth of test cells, which measure 2 by 2 feet. The larger rooms are well insulated, face south, and are heavily instrumented. Collected data can be used in computer modeling to simulate performance in various climates, according to Q-11 staff member Bob McFarland. "The south wall is essentially the only variable," he says. "We can make a parametric analysis for different climates and

DIRECT GAIN WITH CLERESTORY WINDOWS

Direct gain of solar heat can be through ground-level windows or through higher clerestory glazing, which admits light to back rooms. Energy is stored in interior mass walls.



Windows Admit Solar Energy to Back Rooms

validate our models." The test rooms include Trombe-walls, thermosiphon rooms, direct-gain, and styrofoam beadwall. In the latter, the air space is filled with small insulating beads at night and emptied in the morning with a blower system.

The LASL researchers have estimated the performance of passive buildings for different climates. With an 18-inch Trombe-wall, for example, a Los Alamos home could expect to gain 60 per cent of its heat from the sun. Solar energy would provide 60,200 BTU/square foot each year through the wall into the building, projections show. Addition of reflectors or night insulation can increase this to above 200,000 BTU/square foot per year.

Using the same Trombe model, Phoenix, Arizona, could gain 99 per cent of its heat; Bismarck, North Dakota, 46 per cent; and Winnipeg, Manitoba, 22 per cent.

LASL test rooms average 60 to 70 degrees F above the outside temperature on typical midwinter days. Maximum inside wall temperatures are at 4 p.m. on water walls and 4 to 6 hours later on masonry walls.

Two test homes nearby are being monitored to see whether mass manufacturing of solar mobile homes is feasible. Modular I, installed in 1976, features an active collector system of 340 square feet. The collectors, made to LASL specifications, are at a 60-degree slope and heat the 1,056-square-

Builder Wayne Nichols and owner Dave Gunderson inspect the finishing touches on the large shutter which will cover 1 of 2 Trombe-walls in the Santa Fe home. The second thermal wall, behind the 2 men, is on the other end of the crescent-shaped dwelling. The shutters are reflectorized to maximize heat gain when lowered and are insulated with polystyrene to retain wall heat when raised.

foot home with a water storage system. Some 1,536 pint glass jars filled with water store the sun's energy after it is collected by the insulated panels, and 65 per cent of the model's heat was from solar heat last winter. Hot water heating is 85 per cent from solar panels.

Next door, a passively heated module has been installed recently. Modular II was built in cooperation with a Navajo youth training project and has sawtooth clerestory windows in 4 rows on the roof. Sunlight passes, with the aid of aluminum reflectors, onto water bags which lie on the specially trussed ceiling. Solar energy is expected to provide 75 per cent of the heat for the home's 1,080 square feet.

Each of the 2 modulars is well insulated, has a backup electric furnace, and could be built for about $25,000 if factory produced. So far, the industry has been slow to act. "There has been slow response," says Balcomb. "The industry is conservative and public demand has not materialized. When they get 50 inquiries a day, they will start making them."

At the Nambe Pueblo, the Laboratory joined hands last fall with the Indian community and with the Economic Development Administration to construct a solar-heated community building. A solar collector array of 400 square feet, only half of what is normally needed for a 3,000-square-foot building, is located behind a horizontal reflector panel on the roof. The air-medium system, dedicated in October, is expected to provide 65 per cent of the building's heat.

At the Presbyterian Ghost Ranch Conference Center in Abiquiu, 4 guest houses are being monitored to directly compare different design approaches. The buildings, each 960 square feet, feature respectively a Trombe-wall, a greenhouse, a direct-gain window, and a normal wall with 2 small windows.

Collector research at the Solar Lab, where 40 panels are being monitored for weather resistance and surface absorption, has resulted in cost savings for some solar projects. A LASL design incorporates an efficient collector plate with a selective surface in a panel that also serves as the weathertight roofing for a building. A jacketed-tank experiment is now being run to determine whether a heat exchanger integrated in the collector tank will work better than a conventional 2-stage system. LASL research with air-heating collectors has caused increased industry interest in this alternative to the more standard liquid-heating solar panels.

Extensive experimentation at the Study Center is expected to be of use to many solar designers. Each of the 400 collectors has single-pane glass with a black-chrome selective absorber surface. Structural elements are steel; the collector backs are insulated and covered with a fire barrier. Solar energy is

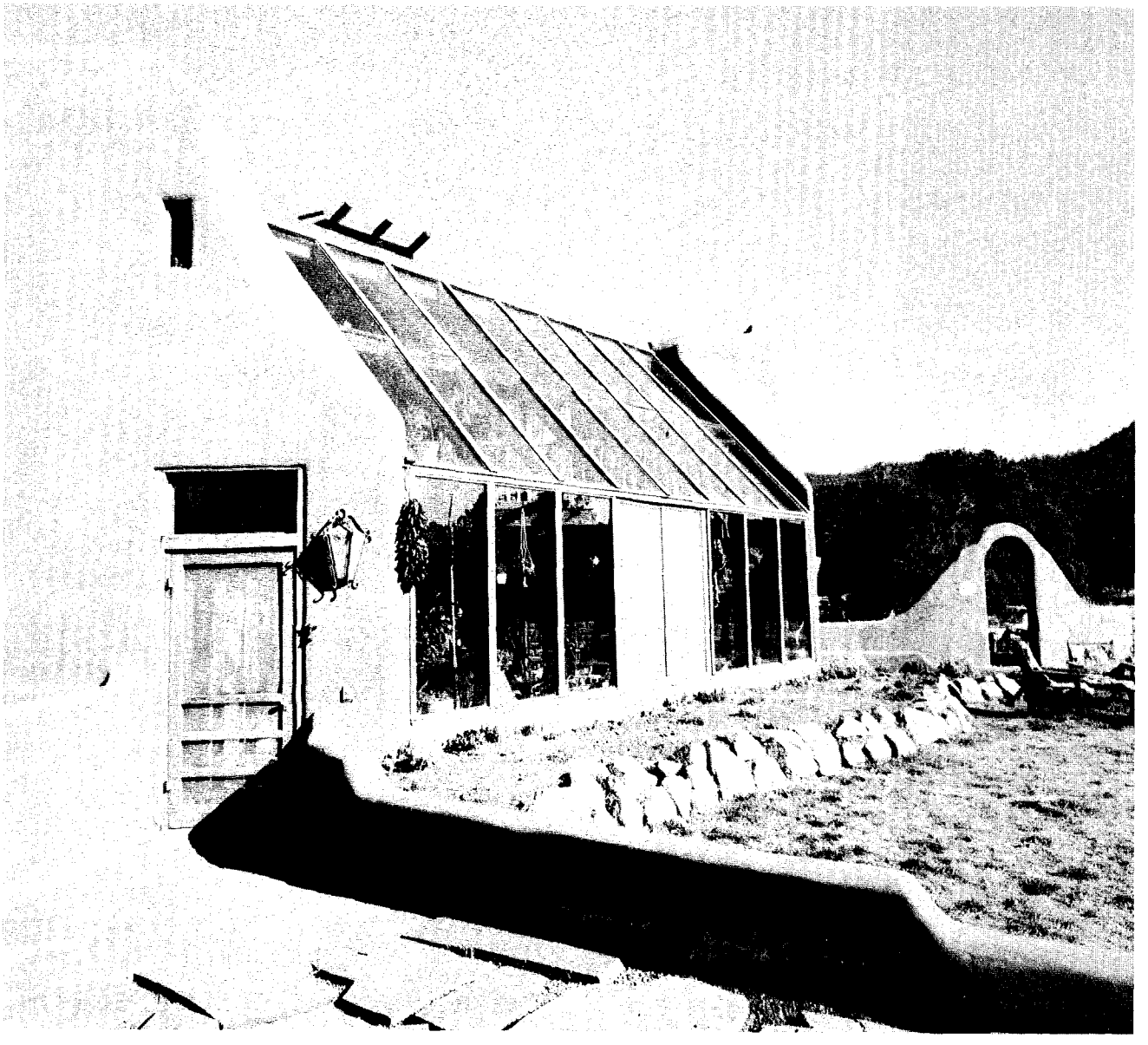
Dave Gunderson demonstrates the simple winch he uses to raise and lower the Trombe-wall shutters. The mechanism could easily be connected to a small electric motor and a timer, he says. LASL's Mike Ulibarry, who investigates monitoring equipment in several buildings, looks on.

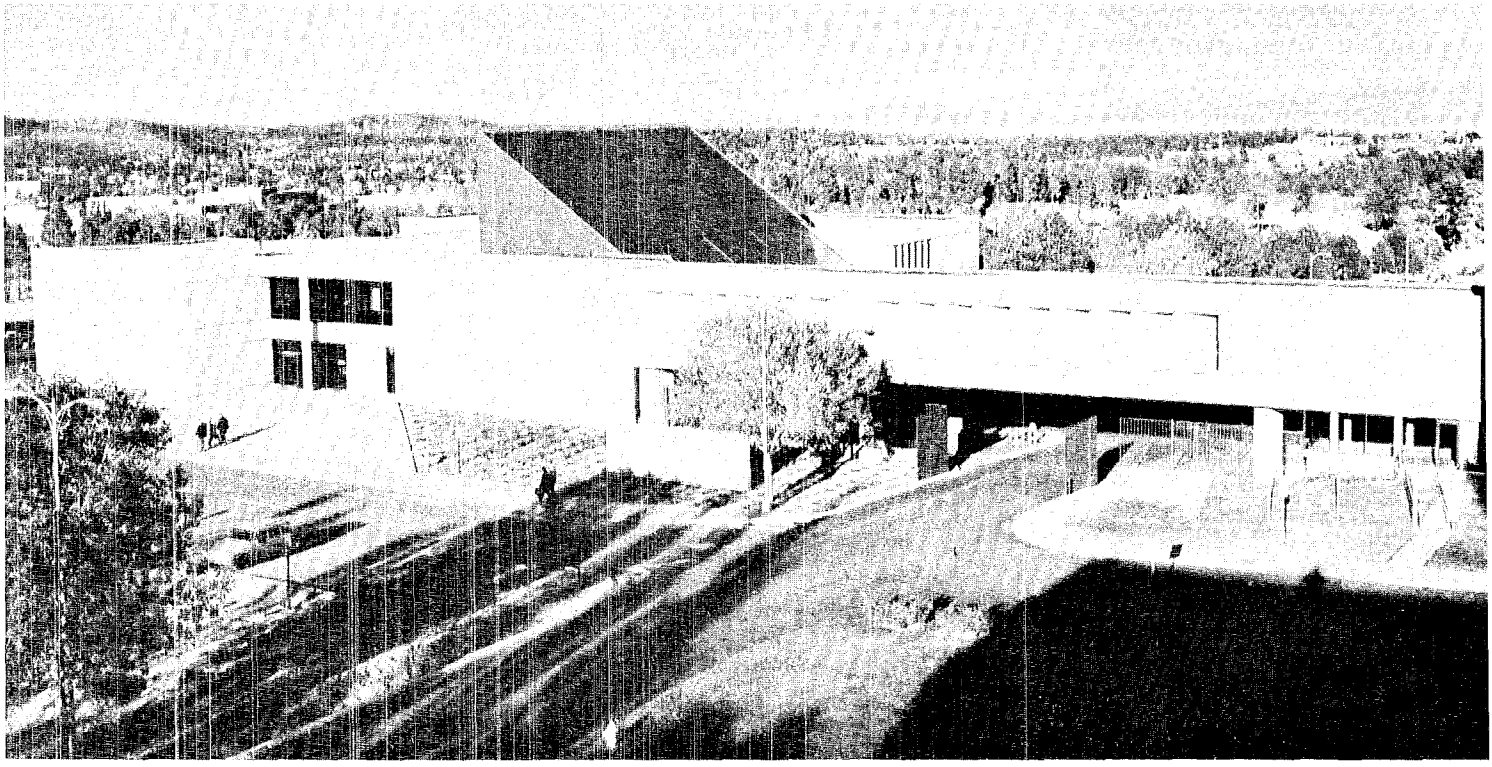
collected by a light oil and transferred to water in heat exchanger tanks. The building is one of the "most elegantly designed, nicely executed solar heating and cooling facilities in the world," says Balcomb. Two cooling systems will provide a side-by-side comparison for performance.

The average homeowner may not be interested in such a major addition, but he or she can add a south-facing greenhouse for as little as $2.50 per square foot, or a solar water heater for around $800 to $1,500. Professional installations of active systems commonly run from $20 to $30 a foot. The major tradeoff is the price of a solar system compared with the cost of fuel during the system's lifetime. Homeowners may also be interested in a few LASL-developed "rules of thumb" for passive solar heat. Few people have a meteorological station on their roof or a thermocouple system in their walls, and Balcomb says, "I don't recommend that we lock ourselves into approaches where the designer has to use computer-aided analysis."

Rule of thumb 1: You need 2 to 3 square feet of south-facing double glazing for each BTU/degree F/hour of additional heat load. In northern New Mexico, this ratio

The striking greenhouse feature of Doug Balcomb's solar Santa Fe home collects heat directly through 400 square feet of thermopane glass. Thick walls inside buffer the living areas, which all open onto the greenhouse, from temperature extremes. A natural ventilation system heats an under-floor rock storage bin and also dispells excess heat in the summer and fall.





An example of LASL's research into active solar energy systems is the recently completed National Security and Resources Study Center near the Laboratory Administration Building.

will supply 70 to 80 per cent of the heat if a building is to be kept within 65 to 75 degrees F. For a well-insulated house of 1,320 square feet, with a south collector wall, 400 square feet of glazing will be needed.

Rule 2: A thermal storage capacity of *at least* 30 pounds of water, or 150 pounds of masonry or rock, should be used for each square foot of south-facing glass. The storage should be in the direct sun; otherwise 4 times this amount will be needed. Thermal storage saves heat until night and prevents overheating during the day.

Rule 3: Shading of south windows, either with shutters or a roof overhang, will reduce summer and fall overheating when the sun is higher in the sky. The windows should be shaded fully at a noon sun elevation of 78 degrees, and should be just shaded at the top at a noon sun elevation of 45 degrees.

Rule 4: The best Trombe (thermal mass) wall thickness is from 12 to 16 inches, and the density of the masonry should be at least 100 pounds per cubic foot. Circulation vents at the top and bottom will increase daytime heating and should have passive backdraft dampers to prevent reverse flow at night.

One of the best examples of passive solar heating is the Pecos monastery, which claims a solar fraction of 95 per cent after a full year of operation. The front third of the linear building is office space, and work-top counters along the south wall conceal the 2 rows of water-filled black 55-gallon drums — 7,590 gallons' worth. Aluminum reflectors on the sidewalk help heat this solar collector, and insulation has not been needed for heat retention when the reflectors are closed on cold nights.

The warehouse design was begun 3 years ago when the monks needed a new home for their religion-oriented Dove Press. The whole construction cost was only $13.50 a square foot. The Benedictine Brothers now have 2 additional drumwall buildings, each 5,000 square feet, under construction. Four buildings now have solar hot water systems, and 4 more heaters are in the offing.

A handy ratio for the monastery has been one drum for each 22 square feet of floor space. The anterior portion, 5,500-square-feet worth of warehouse, is heated only by direct-gain through high clerestory windows. It has never fallen below 45 degrees F despite outside temperatures of 14 degrees below zero, and the book cartons and shelves themselves provide the needed thermal storage. A heavy thermal wall separates the 2 areas.

On winter afternoons, daytime temperatures in the offices are made comfortable by venting excess heat into the warehouse and by opening windows.

Double rows of vents — along the floor and along the counter top — can be adjusted to control the natural air flow around the drums. Each office room can be "tuned in" foot by foot. The offices have never dropped below 63 degrees F and the solar system is paying for itself in just 2 years. Supplemental heating is supplied through electric wall panels.

Such complexes are still uncommon. Passive systems are found more often in custom-built homes, such as the beautifully designed double-Trombe residence owned by Gunderson in Santa Fe. Manually operated winches easily raise or lower insulated panels outside the thermal walls. The panels are also reflective and when lowered during the day serve to increase the energy collected by the walls. Such homes are expensive; but retrofitting projects — such as a greenhouse addition being monitored in Anton Chico, New Mexico — may provide a new thrust for the homeowner facing high utility bills.

LASL's solar efforts are multifaceted, or "fluid," says Q-11 staffer Merily Keller. For the Department of Energy, over 100 contracts are monitored and checked, and 80 of those are out of state. Handbooks and papers are available to the public, and the staff often is asked a multitude of technical questions. But since LASL's main role is to provide research and analysis for DOE, inquiries are usually referred to the National Heating and Cooling Informational Center, Box 1607, Rockville, Md. 20850. Their toll-free number is 1-800-523-2929. In addition, persons can contact the New Mexico Solar Energy Association in Santa Fe, New Mexico, at 505-983-2887. International Solar Energy Society chapters may also be found in many other states.

"To me," says Balcomb, "the crux of the matter is whether or not it's available to a wide variety of people. If it's cost-effective, and widely available, use it. Three years from now we will probably be seeing the fruits of the research and development — which has started — factored back into widespread application."

New Mexico, energy rich, exports 90 per cent of its bounty and uses 10 per cent.

"We don't expect to export our solar energy, though," says Balcomb, "at least not yet."

Panorama Press New Atom Printer

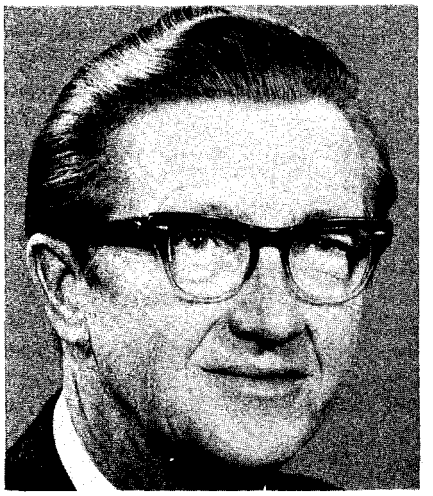
For 14 years **The Atom**, from volume 1, number 1, was printed by the University of New Mexico Printing Plant in Albuquerque. Beginning with this January-February issue, however, the magazine is being printed by Panorama Press in Albuquerque.

Panorama was successful bidder on **The Atom** contract for this coming year.

The Atom staff is looking forward to a good, creative working relationship with Panorama, managed by Tom McNatt and Don Miller.

And, we want to say "thank you" to the UNM Printing Plant for their many years of good service and quality work.

The magazine will retain its basic format, with only some slight changes in body text and headline styles. As **The Atom**-Panorama relationship grows, however, we expect to make some additional changes in graphic design.



David B. Hall

David Hall Retires

David B. Hall, LASL employee since 1945 and former leader of R-Division, retired in January. He now is a consultant to the Laboratory's Q-Division, and is a member of the Atomic Safety and Licensing Board.

Hall started at LASL in November 1945 and was group leader for implosion testing (RaLa) from 1945-1947. From 1947 to 1951 he served as group leader in charge of building and operating the first fast plutonium reactor — Clementine.

He was alternate leader of W-Division from 1952-56, and from 1956 to June, 1970, division leader of K-Division, reactor development. During his service with this division, he supervised construction and operation of LAPRE II, LAMPRE I and the UHTREX.

In 1970 he was named leader of the Assay and Accountability Division, a safeguards research and development program, and in 1975 he was named head of the new Reactor Safety and Technology (R) Division.

Before coming to Los Alamos, Hall was physics instructor at the University of Denver, associate physicist at the University of Chicago Metallurgical Laboratory, and was a physicist at the Hanford Engineer Works, Hanford, Wash.

Hall is a Fellow of the American Physical Society and American Nuclear Society.

short subjects

A new division entitled Accelerator Technology (AT) was formed January 1 with **Edward A. Knapp** as division leader. The AT-Division will apply particle accelerator techniques to problems related to national defense, to medical therapy, to the development of high-current particle accelerators for applications in nuclear fuel production, to development of a proton storage ring, and to the development of other accelerator technology as requested by the federal government. **Robert A. Jameson** will be alternate division leader.

* * *

The Best Paper Award at the American Nuclear Society's winter meeting in San Francisco was given to 4 scientists from LASL and to 1 from the Union Carbide Corporation at Oak Ridge, Tenn. The paper was presented by Cleo C. Byers, Q-14. It was written by him, Jerry J. Koelling, Gordon E. Hansen, and David R. Smith, all Q-14, and by Howard R. Dyer of Union Carbide. The paper was titled "Critical Measurements of a Water-Reflected Enriched Uranium Sphere."

Joseph L. Cowan

Legal Liaison Director Is Joseph Cowan

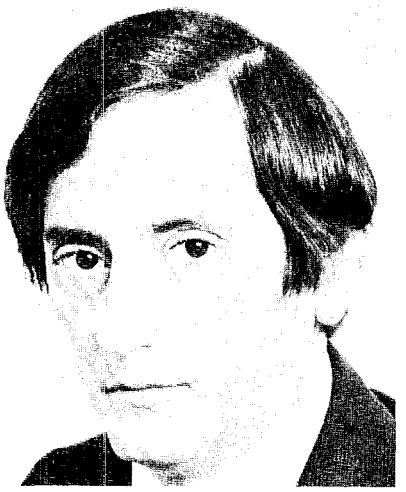
Joseph L. Cowan, Jr., former assistant counsel to the Regents of the University of California, has been named assistant director for legal liaison at LASL. He will succeed Philip F. Belcher when he retires later this year.

Cowan has served his alma mater, Berkeley, during much of his career. He began as personnel analyst in 1964, was named senior personnel analyst in 1966, and later became a staff coordinator in the office of the UC vice president for administration.

As assistant counsel to the UC Regents he was attached to the office of the general counsel. In this capacity he served as attorney for the San Francisco campus, acting as advisor to a wide range of administrative and academic managers on a variety of legal issues. He also served as legal advisor and legal representative in matters involving other University of California campuses and laboratories.

A native of Providence, R.I., Cowan earned his A.B. degree from the University of California, Berkeley, in 1963. He received his J.D. at Golden Gate College, San Francisco, in 1972, and holds a certificate, obtained in 1974, from Hastings College of Law College of Advocacy.

Cowan is a member of the California Bar Association, the National Health Lawyers Association, and the American Society of Hospital Attorneys.



David L. Moore

Moore Named PR Head

David L. Moore, former public information officer for the Association of Universities for Research in Astronomy (AURA), will head LASL's new Public Relations Department formed effective January 3.

The new department will have as its nucleus PUB-1 (Public Information), formerly ISD-1, and PUB-2 (Public Relations), formerly ISD-2.

Moore comes to LASL from Tucson, Ariz., where he served 4 years as director of public information for AURA, a nonprofit management group under contract to the National Science Foundation in Washington, D.C., to operate 3 major nationally funded centers for research in astronomy. These include Kitt Peak National Observatory in Tucson, the Sacramento Peak Observatory in Sunspot, N.M. and the Cerro Tololo Inter-American Observatory in La Serena, Chile.

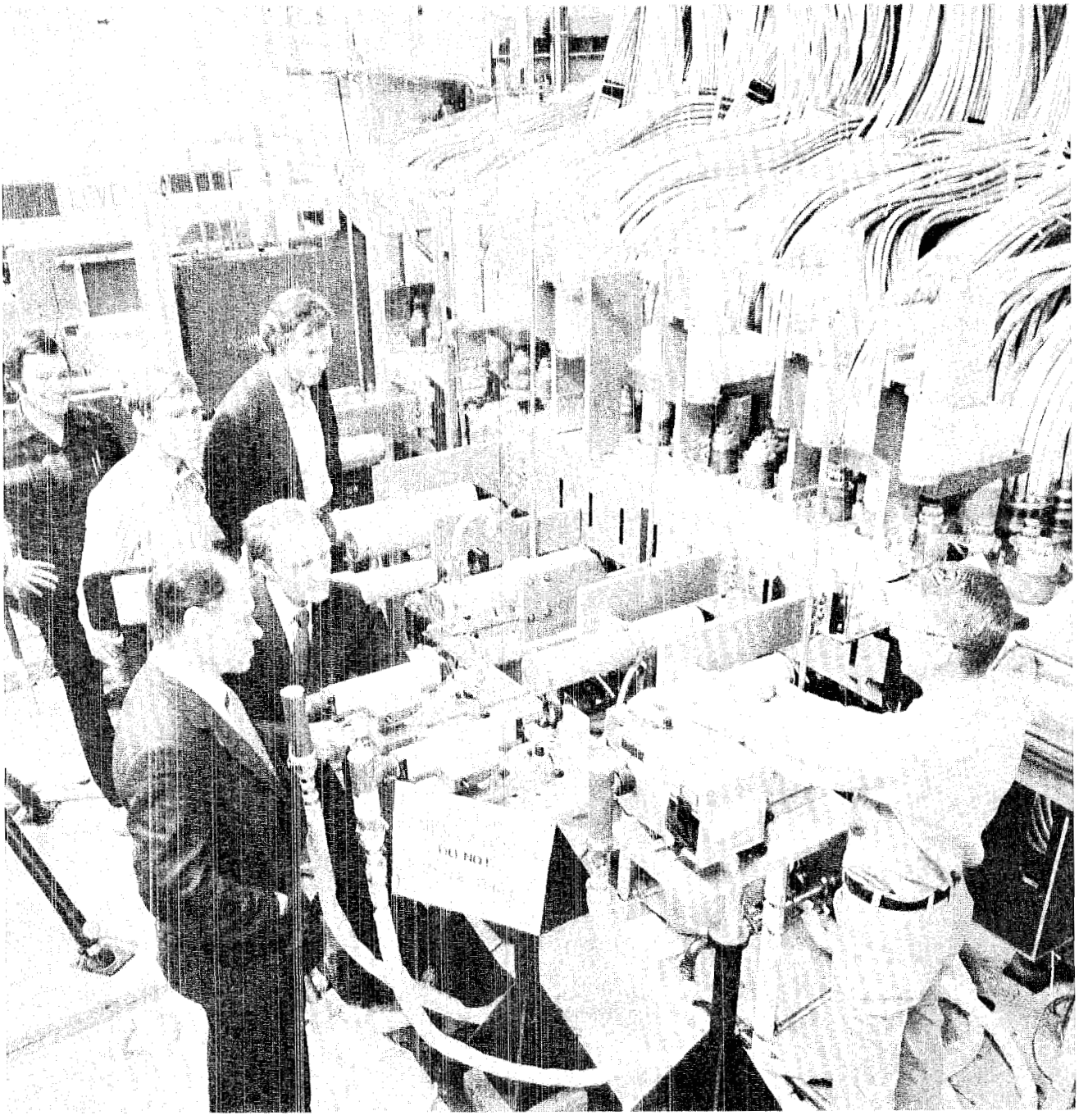
Before joining AURA, Moore was a writer, photographer, and illustrations editor for the National Geographic Society in Washington, D.C.

Moore was educated at Montgomery Community College, Rockville, Md., the University of Maryland, and the Memphis Academy of Arts.

Among Our Guests

In the top photo, Jim Hedstrom, Q-11, explains the operation of the solar heating and cooling equipment at the National Security and Resources Study Center to Congressman Barry Goldwater, Jr. Below, LASL Director Harold Agnew greets Gen. Richard H. Ellis, right, Commander in Chief, Strategic Air Command, and Maj. Gen. Kelly H. Burke, deputy chief of staff for plans, Strategic Air Command, as the 2 generals arrived at the Los Alamos Airport recently for a tour of the Laboratory.

Four Soviet scientists attended a workshop on feedback stabilization hosted recently by LASL's Controlled Thermonuclear Research (CTR) Division. Included in activities for the visitors was a tour of the Scylla IV-P magnetic confinement experiment. The tour was conducted by CTR associate division leader Warren Quinn, far right, and CTR-3 group leader Richard E. Siemon, far left. The Russian visitors were V.A. Chuyanov of the Kurchatov Institute in Moscow, V.F. Gubarev of the Cybernetics Institute in Moscow, Yu. K. Kuznetsov of the Karkov Physical Technical Institute in Karkov, and I.V. Mozin of the Efremov Institute in Leningrad.



LAMPF Builds New Remote Manipulators

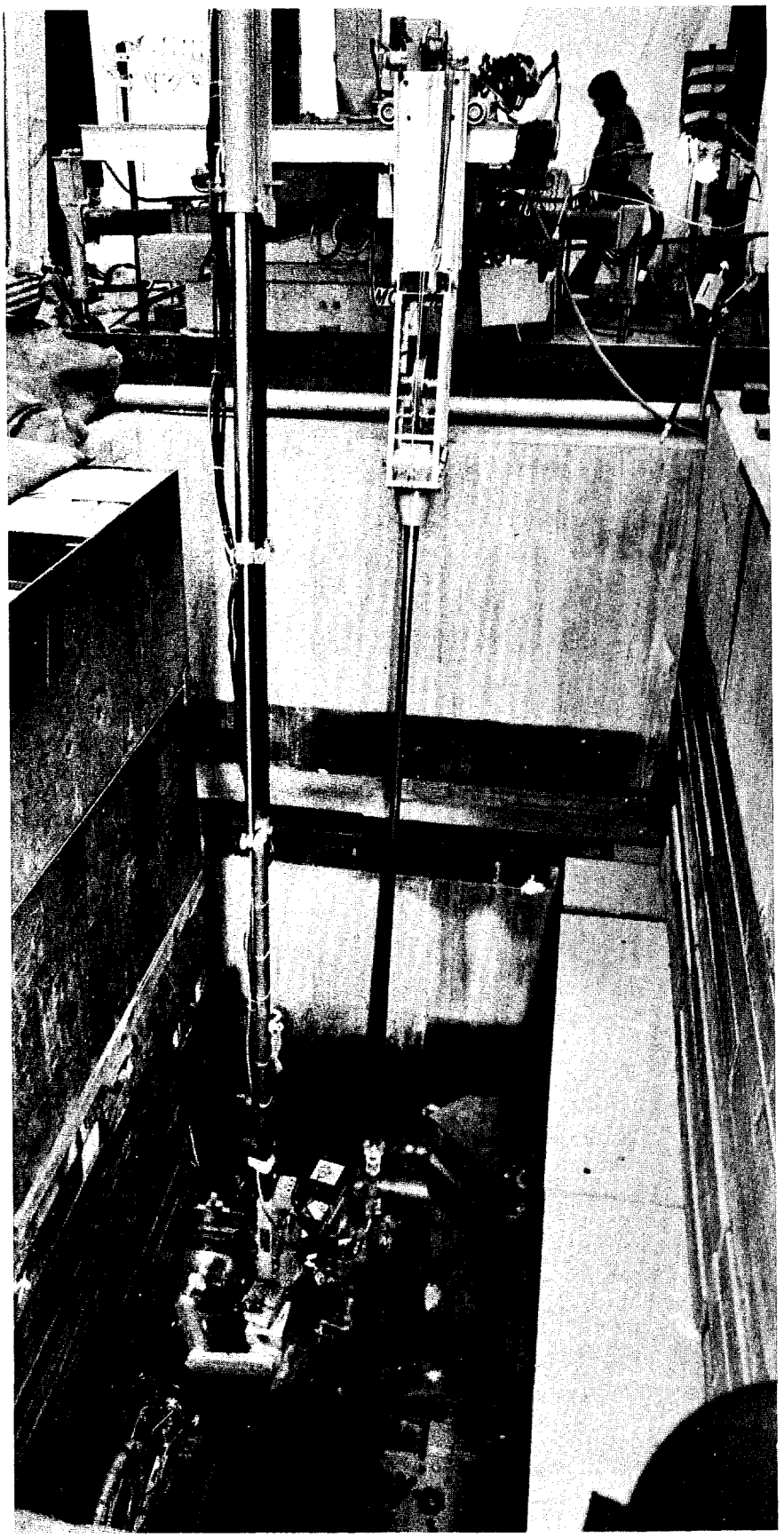
By Barb Mulkin

They're using slave labor out at LAMPF, and Ethen Ekberg and Don Grisham, MP-7, aren't the least bit apologetic about it.

The slave is a remote manipulator that is used for maintenance and component replacement in the target cells of the main experimental line, where induced radiation levels are so high that maintenance and repair cannot be done manually.

A single remote handling system is operating, and a second unit will be completed next spring. With beam time worth an estimated $4000 per hour, the manipulator system is considered a big money saver, in addition to being "a doer of the humanly impossible," as Ekberg puts it.

LAMPF — the Clinton P. Anderson Los Alamos Meson Physics Facility — has the highest beam current of any proton accelerator in the world, and, as Grisham explains, the higher the beam current, the higher the radiation levels.



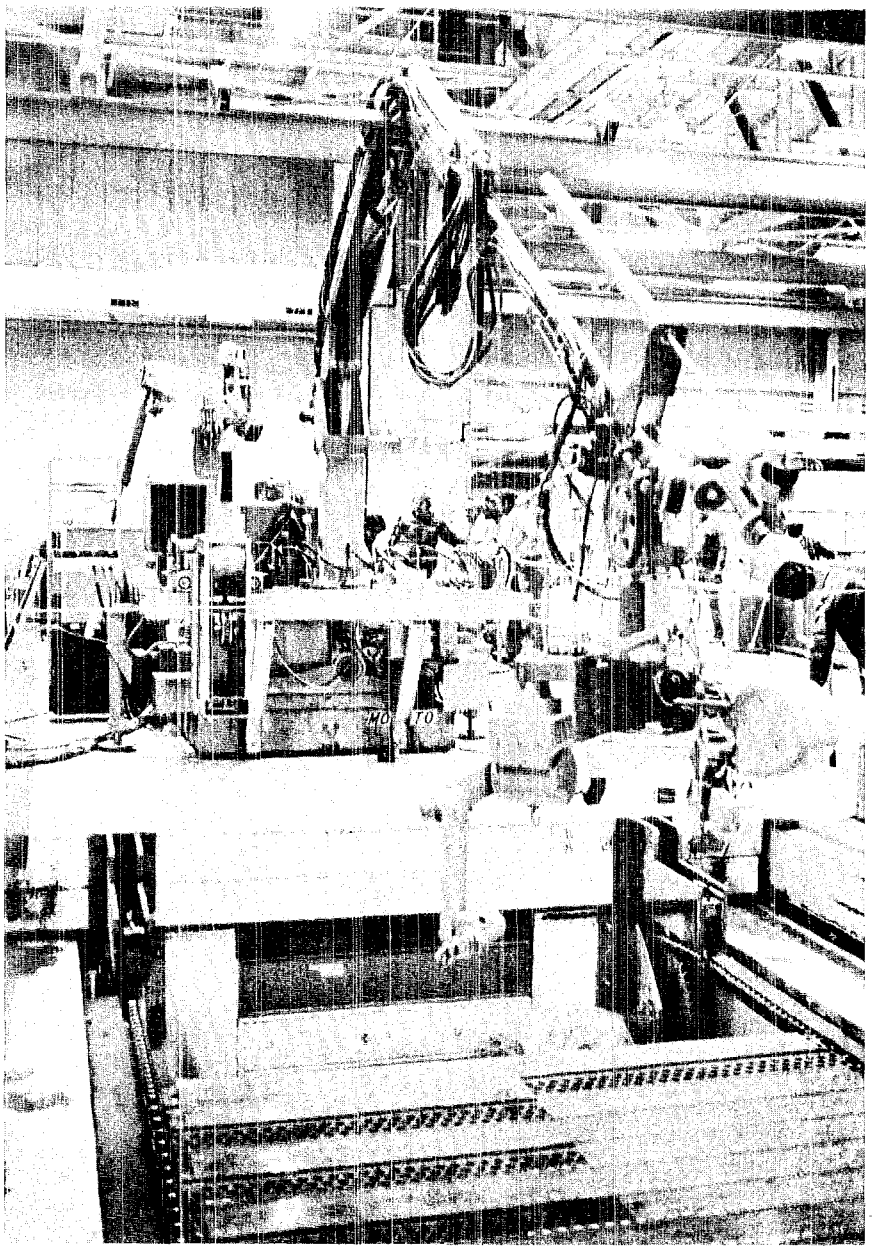
An earlier version of the slave unit monitoring equipment is shown in place in the beam stop in Area A at LAMPF.

Maintenance and repair are major headaches under such conditions, and accelerator researchers are constantly working to devise ways of handling this problem.

Until 3 years ago, LAMPF scientists were preparing to work in the target cells with "Merrimac," a portable hot cell coupled to a gantry, but its design posed problems. For one thing, it weighed 250 tons, most of it in what was thought to be necessary shielding, and thus moved exceptionally slowly. For another, LAMPF researchers discovered that the routine maintenance and repair in the beam line did not require such extensive shielding.

"Something else was needed," Ekberg comments, "something capable of more rapidly reaching most areas in the beam line, and especially, something able to operate easily in radiation fields where extensive shielding was not needed."

That something was the small, sophisticated master-slave unit now in operation.



MP-7 personnel, left to right, Johnny Herrera, Ross Meyer, Marion Wickham, Lynn Brewer, and Ethen Ekberg inspect one of the remote manipulators at a practice hole in Area A.

The manipulators for the system were fabricated by TeleOperator Systems Corporation, New York, to specifications determined by MP-7 personnel and visiting LASL staff members R.A. Horne of CERN, Switzerland, and Joseph Burgerjon of TRIUMF, Canada. Although this type of manipulator was available in Europe, it was placed with the small U.S. company for development to satisfy an American need for advanced manipulators. The LAMPF unit was incorporated into a total remote manipulator system with the aid of MP-7 staffers Lynn Brewer, Johnny Herrera, Jim Lambert, Lon Martinez, Ross Meyer, and Marion Wickham, and was christened "Monitor."

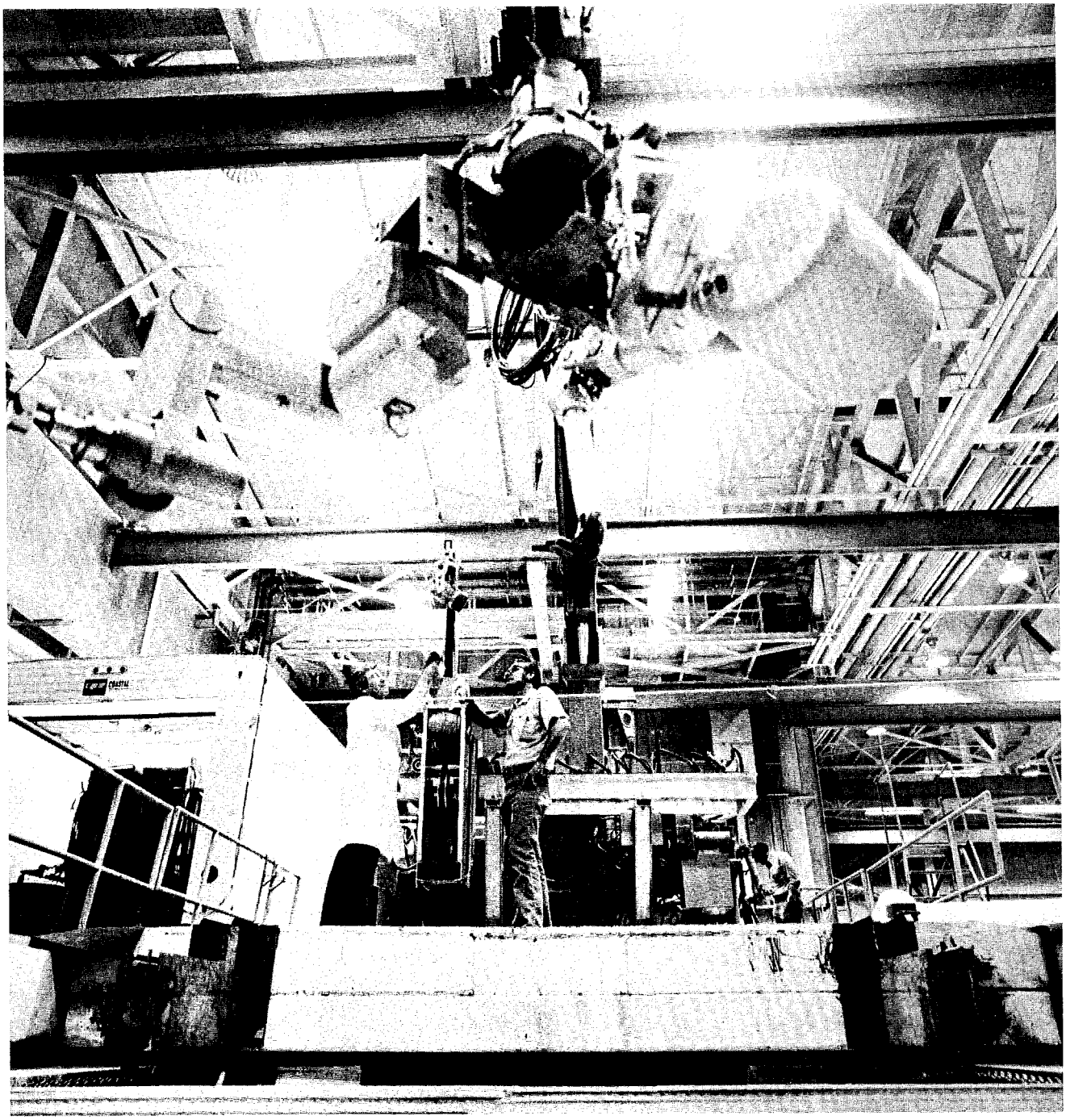
Some of Monitor's functions are unique, allowing an unprecedented latitude to the operator in manipulating components as far away as 100 meters. The unit is portable, versatile, and, after 6 months in operation, is performing even better than was expected, according to Grisham and Ekberg.

Grisham credits Monitor, which he describes as one of the most advanced remote manipulator systems of its kind in the world, with literally extending 3 of an operator's 5 senses — those of touch, sight, and hearing.

"It (Monitor) is the state-of-the-art in remote handling," he says.

The slave unit is a manipulator that is trailer mounted for easy movement. It is connected by cables to a master unit that, together with monitoring equipment, is housed in a mobile unit that can also be easily trucked to any part of the facility.

In a typical operation, the shielding is removed from a beam area where work needs to be done. The slave, which is mounted on a hydraulic boom, can reach as far as 6 meters into the target cell cavity. It is guided by the master unit, which is manipulated by an operator who can watch on a television screen what is being done, hear through a microphone lowered into the beam area, and feel what is being done with the slave — a phenomenon, called "force reflection," the unit's key to versatility.



Lon Martinez, MP-7, left, and Wickham operate a manipulator. At left is the trailer containing controls for the remote handling units.

To obtain a quality television picture for the operator, Ekberg adapted a commercial light unit esoterically billed by the manufacturer as "The Thing from Outer Space," because it was first developed for use as an antenna on spacecraft and because of the way it operates.

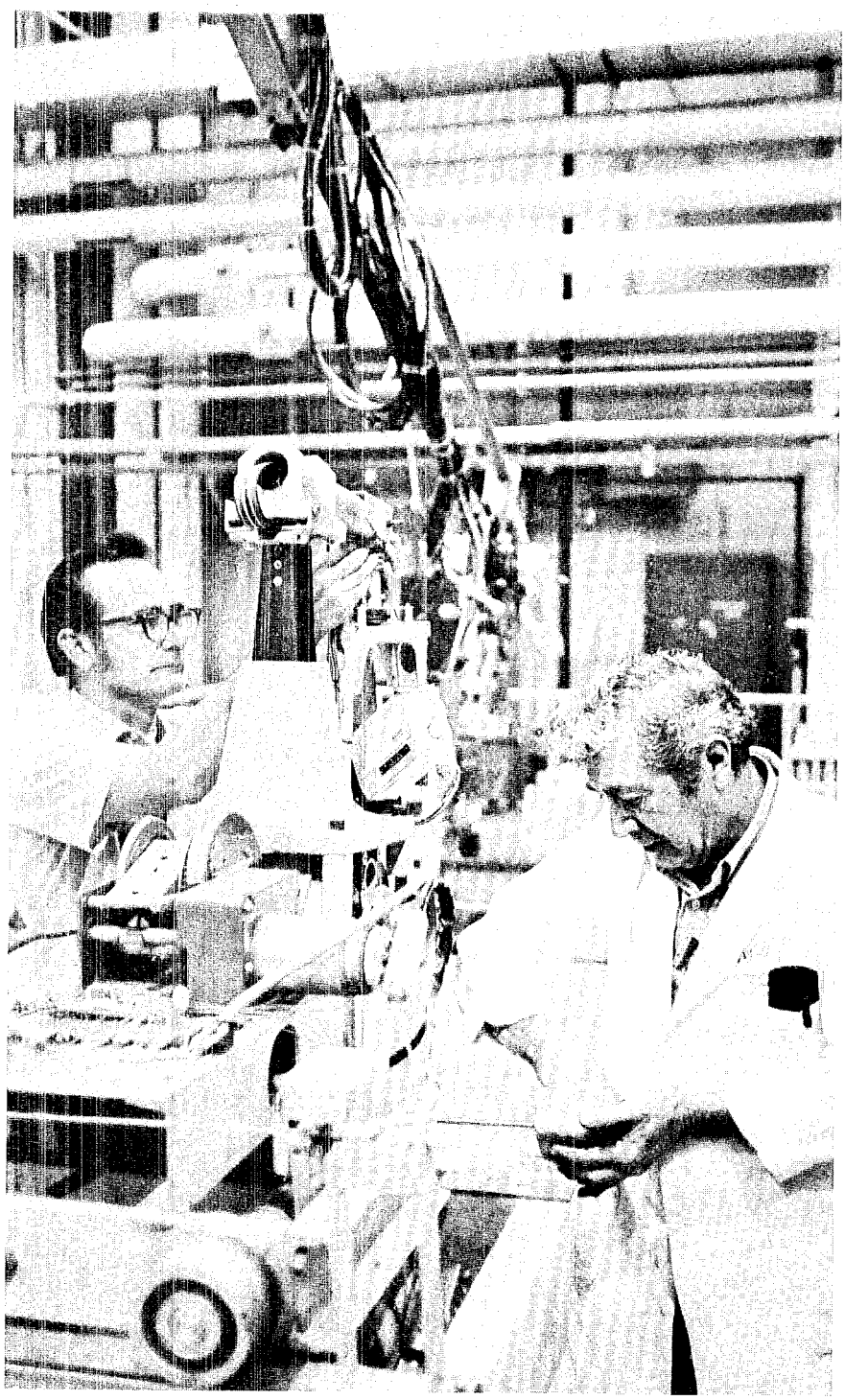
The unit's trade name is "Stem-Lite." As adapted by MP-7, Stem-Lite is a compact, 16-inch-high unit consisting of 2 thin strips of rolled stainless steel wound on a pair of 2-inch-diameter spools. They unwind to form a mast up to 12 feet tall when activated by a winch powered by a 12-volt battery pack. Flexible, but amazingly strong, Stem-Lite is used at LAMPF to support a television camera and a light suitable for TV exposure.

Ekberg's initial equipment was all "off-the-shelf," but considerable effort has been expended by MP-7 scientists to provide the highly specialized versatility that the system had to deliver.

The master-slave unit now in operation can be used in conjunction with a crane for heavy jobs, or it can be operated alone for work that merely requires dexterity. In either case, Ekberg estimates that the unit can perform a given chore 40 times faster than electro-mechanical manipulators.

Recently, Monitor was used to replace a volume window assembly at LAMPF near the main beam stop. Grisham estimates that radiation in the area was about 20,000 rad per hour. Working from a mobile unit 50 meters away, an operator was able to find, and remove, the necessary bolts so that the tube could be lifted from the cavity by an independently operated crane. Water lines and other components were removed, then reinstalled with the new remote system, and the job, a major one, was completed in 3 weeks of previously scheduled LAMPF down time.

After such a job is completed, Monitor's slave manipulator can be decontaminated readily by wiping with a damp cloth.



Wickham and Martinez are pictured with a stem unit for the manipulators.

Although Merrimac will be kept in reserve for some tasks, it has been replaced by Monitor in most of the routine beam line maintenance, and this provides an ironic twist to the story.

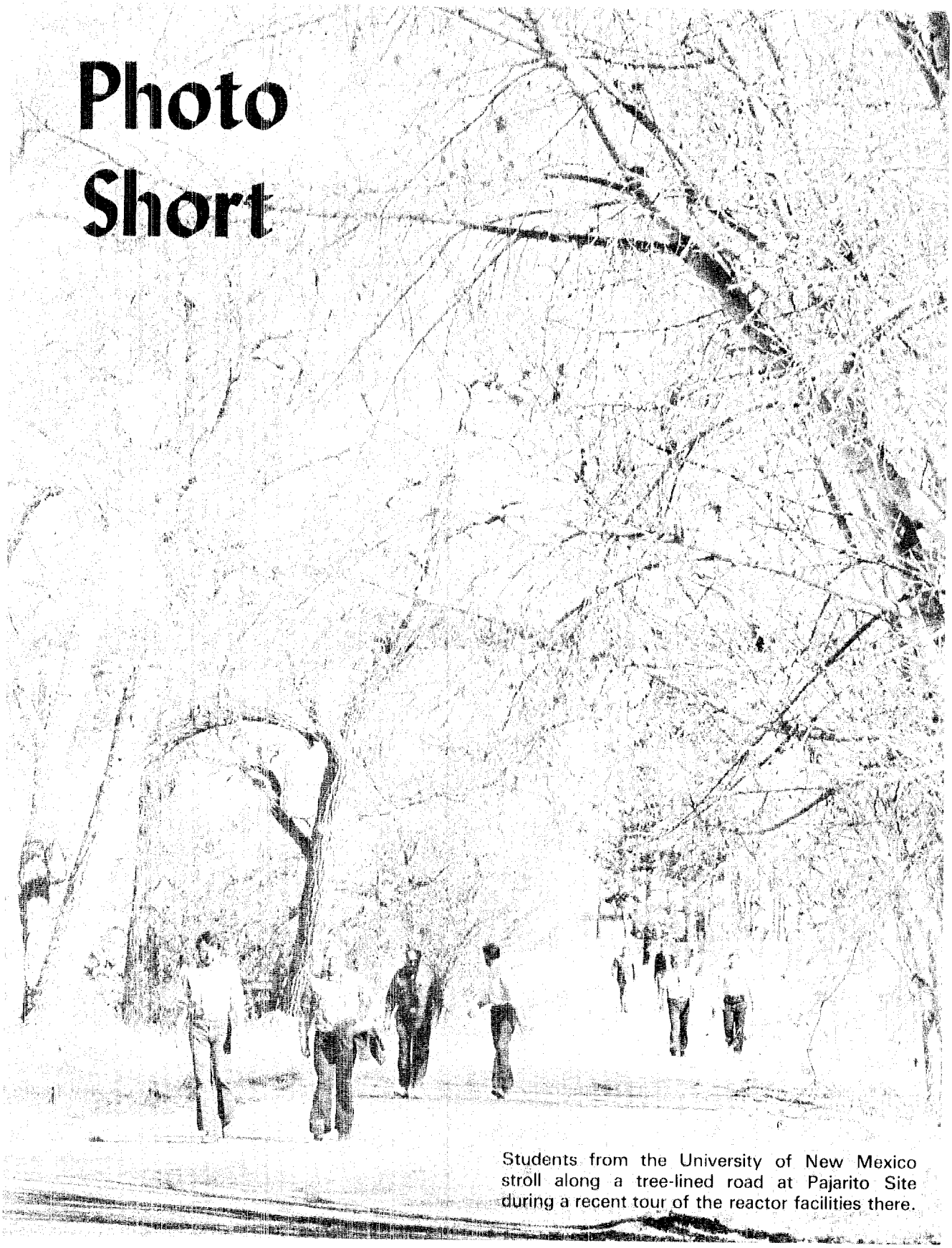
Merrimac was named for the steam frigate scuttled by Union forces at the beginning of the Civil War shortly before they abandoned the Norfolk Navy Yard at Portsmouth, Virginia. She was subsequently raised by the Confederates, renamed the Virginia, and converted into a formidable ironclad — large, clumsy, and slow — which later engaged in combat with the Union Navy's ironclad — Monitor.

Grisham, a history buff, says Monitor had a revolving turret, which allowed it to aim its guns in any direction, while Merrimac's guns were fixed in one position.

"Monitor's revolving turret was a prototype, which worked so well that it became the standard for everyone's naval vessels. It was so versatile, it changed the face of naval warfare . . ."

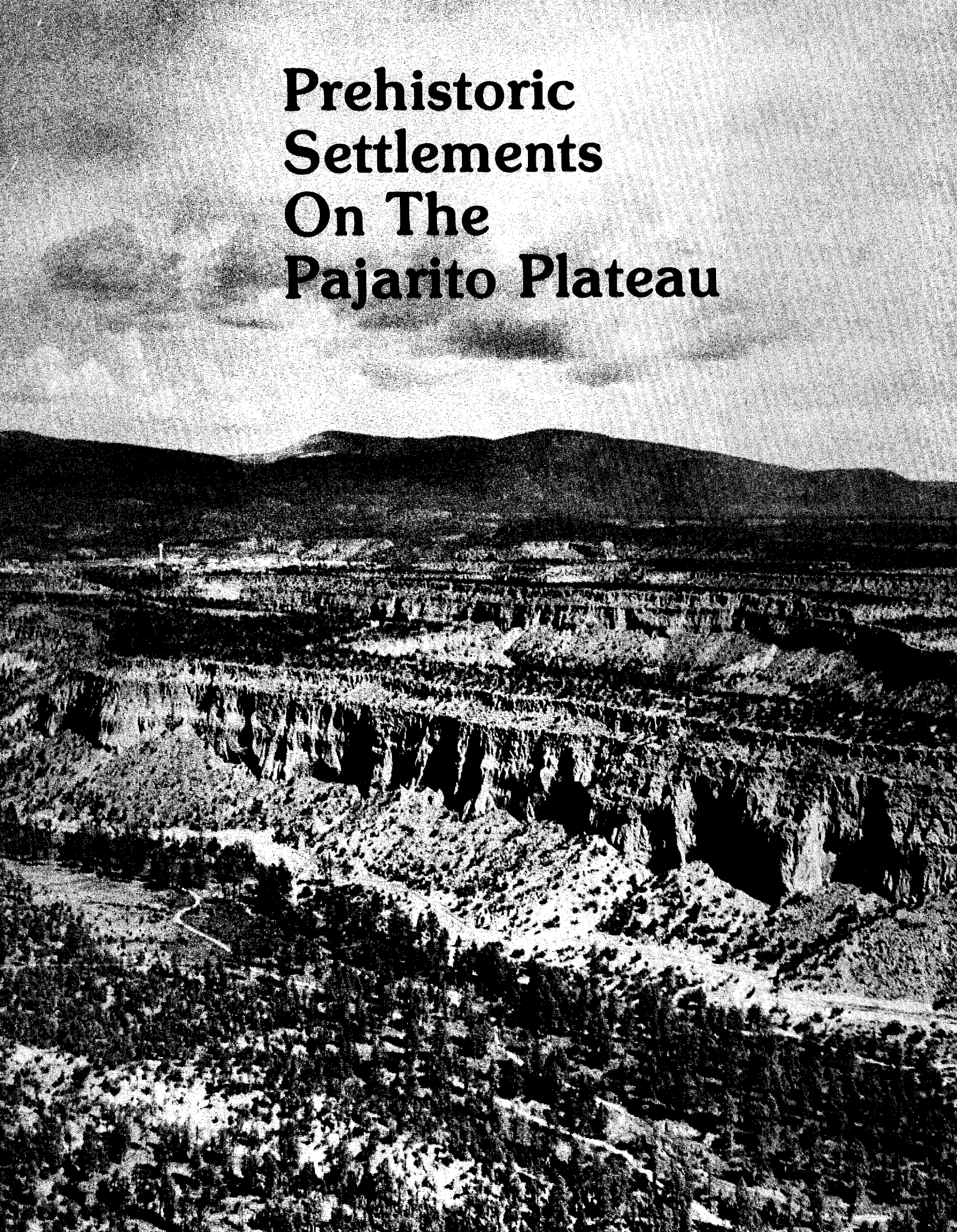
Ethen Ekberg, foreground, and Herrera, Wickham, and Lynn Brewer, MP-7, watch monitors in the control console trailer.

Photo Short



Students from the University of New Mexico stroll along a tree-lined road at Pajarito Site during a recent tour of the reactor facilities there.

Prehistoric Settlements On The Pajarito Plateau



EDITOR'S NOTE: This is the second of several articles on the archaeological investigations of the Pajarito Plateau which will appear in *The Atom* during the next few months. The first article, describing the history and background of early investigations in this area, appeared in the October 1977 issue of the magazine. The information in "Pajarito Plateau Archaeological Survey and Excavations," LASL 77-4, by Charlie R. Steen, archaeological consultant to LASL, serves as the basis for the series of *Atom* articles. This article is about the types of early, small settlements, and the estimated periods of habitation by the people of the Plateau.

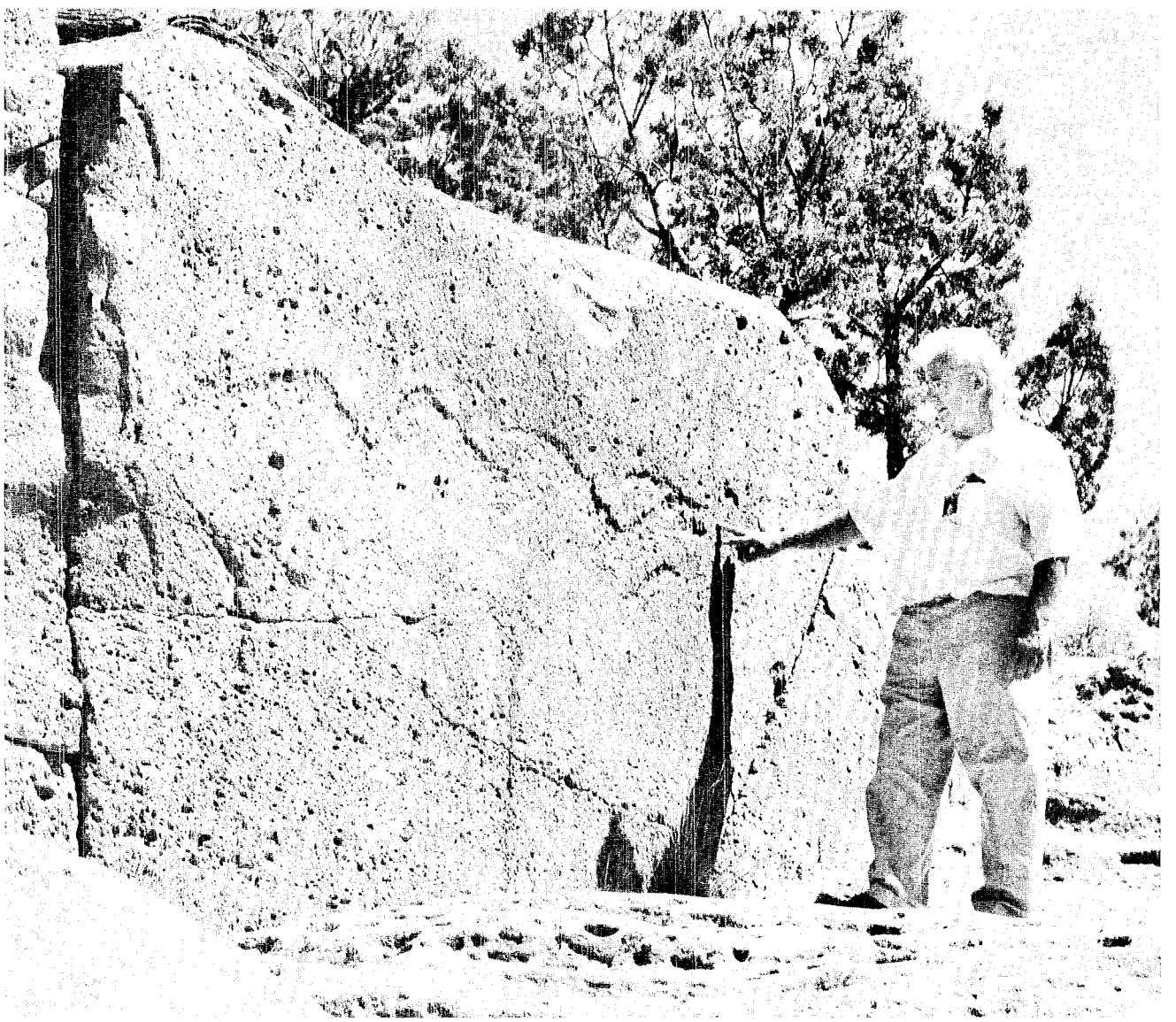
Surveys of the Pajarito Plateau reveal some patterns of site location determined at least partially by environmental and social factors.

The first settlements were nearly all built on crests or ridges on the mesa tops to ensure the builders of adequate drainage at or near the houses.

Elevation also appears to have been important in determining the extent of population spread on the mesas. Localized air currents played a part in the length of the growing season. There probably were more frost-free days at higher elevations on some mesas than on others.

Late in the 13th century, at the beginning of the intensive occupation of the Pajarito Plateau, the population seems to have been pretty evenly spread on the mesas. The Indians were building larger housing units and living at lower elevations, however, by the latter part of the 14th century. By the 15th century, the small individual farms and villages appear to have been abandoned, and the population was concentrated in large settlements such as Tshirege, Tsankawi, and Otowi, and in villages clustered around plaza sites.

LASL archaeologist Charlie Steen inspects prehistoric Indian rock art at a site on the Pajarito Plateau.



Construction of the houses or villages indicate that none of them seem to have been fortified against human enemies.

Archaic projectile points have been found sporadically on the Pajarito Plateau, but no evidence of settlement during the archaic period has been recorded. Archaeologists assume that hunting parties went onto the plateau but made no permanent camps.

Many of the archaic points found on the plateau resemble types found in the Southwest from about 1,000 B.C. to about A.D. 700. Some were found in levels containing pottery, and others were of the preceramic period.

LASL archaeological consultant Charlie Steen reports that a fragment of a Folsom point was found several years ago on the mesa north of Ancho Canyon, and recently another was found near Totavi, but there have been no reports of findings of other pre-Archaic artifacts on the plateau.

Researchers estimate that it was probably late in the 13th century when the unpopulated Pajarito Plateau had an influx of puebloan settlers. Family-sized house blocks were built from the rim of the White Rock Canyon at the Rio Grande up to about 7,400 feet (2,400 meters) elevation. The greatest concentrations of settlements are at 2,150 to 2,350 meters (6,600 to 7,200 feet), and it is assumed that the mesa top environment at that elevation offered optimum conditions for primitive horticulture. The houses were built along the crests of the mesas, where drainage is best.

Most farming probably was done on the mesa tops, because where sites are most concentrated the canyons below them are narrow and deep and there is little arable land. Also, the narrow canyon bottoms are chilly in winter, and the growing season would be too short for crops.

The mesa tops probably were stripped of all vegetation except for the crops and some weeds.

It would be extremely difficult to estimate the population of these mesa top settlers, but researchers figure it was small — probably a few dozen persons on a mesa, living in small house blocks spread along the top of the mesa. The house blocks were occupied for a short period, probably a generation or less. This tendency for brief habitation is a common occurrence in primitive communities, where the people moved for reasons such as death, bad luck, or evil spirits plaguing the house.

Nearly all the houses excavated within the survey area had been cannibalized; roofing timbers and most of the stone had been removed for reuse at another location.

Santa Fe Black on White, dated at A.D. 1225 to 1350, is the predominant painted pottery found on the surface at these small sites. Some sherds of Galisteo Black on White, 1300 to 1400, and St. John's Polychrome, 1100 to 1250, are found in them, and rarely, some Wiyo Black on White, dated 1300 to 1400. These finds indicate the small farmsteads probably were occupied between 1250 and 1350.

At some undetermined time, the settlements grew, and the house blocks became a double or triple row of rooms, aligned north-south. The most common painted pottery at the 2 sites of this type that were excavated is a mixture of Santa Fe and Wiyo Black on White.

Plazas, created by extending rows of rooms eastward from the north-south room blocks, were a further development. In the plaza there often was a kiva, the earliest appearance of the circular, detached kiva on the Pajarito Plateau. The common pottery here, too, was Santa Fe and Wiyo Black on White.

In the latter part of the 14th century, changes appeared in the settlement patterns, and apparently in the religious practices of the people of the Plateau.

The high elevations seem to have been abandoned, and the population gathered on the lower eastern parts of the mesitas. A climate change could have initiated the move, or it could have been the fact that the lower, wider parts of the canyon bottoms, with alluvial soil, were cultivated for the first time. Small dams across minor drainage channels in the canyon bottoms and on the mesa tops appear at this time. This also seems to be a period at which the heat-retaining properties of basalt exposures were put to use for garden plots.

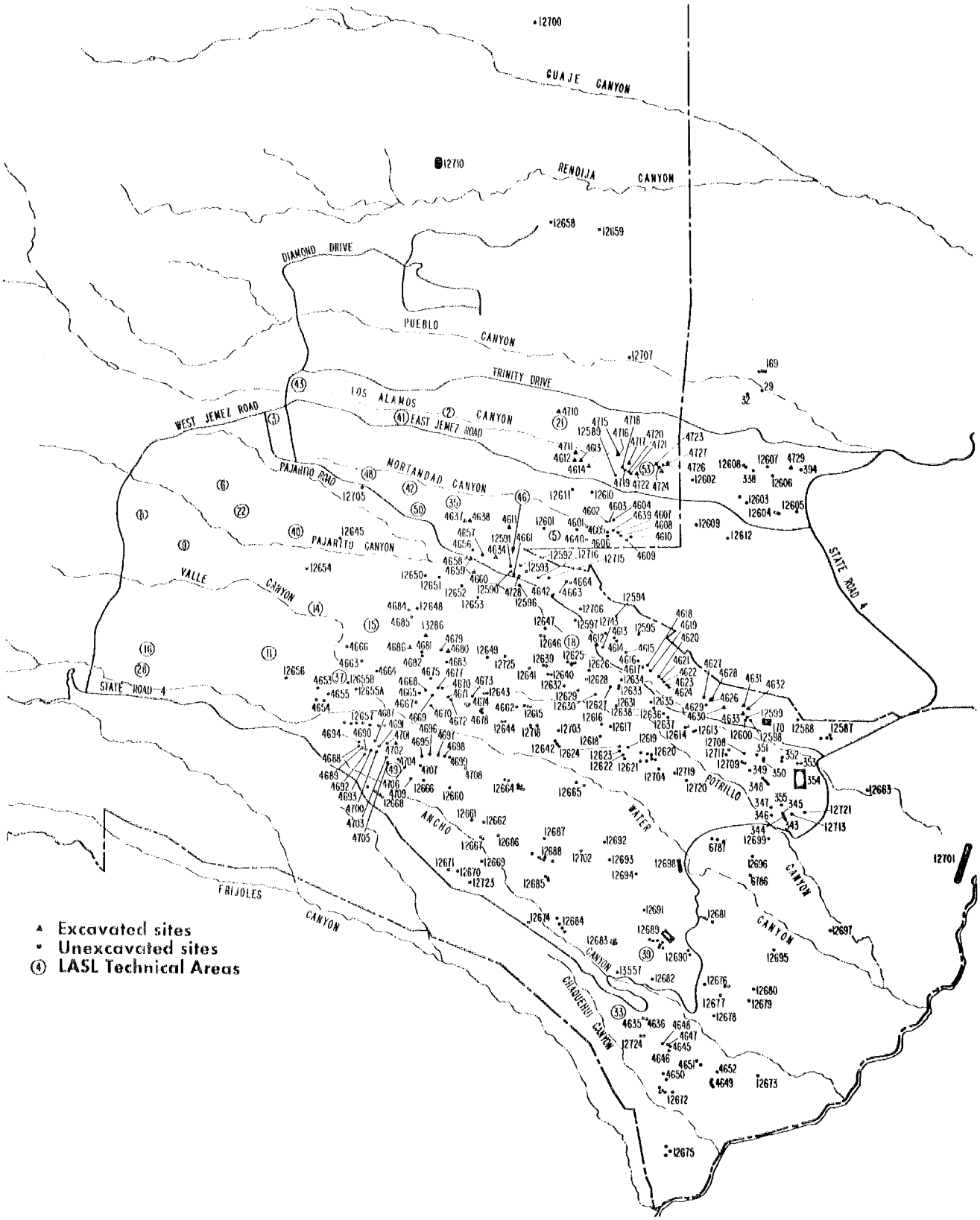
Tshirege, Otowi, and Navawi sites probably were started at this time. These are large house blocks built around open plazas that face south. Another apparently contemporary development was the construction of villages associated with a rectangular house block built around a plaza that sometimes had a narrow entry on the east side.

At the time the larger settlements were being built, the people also began to dig the cavate rooms in southward facing cliffs on the Plateau. Many of these rooms appear to have been for ceremonial purposes.

The Pajarito Plateau was abandoned in the late 16th century, according to research based on dendochronological records. The last cutting dates of room timbers on the Plateau may have been about the middle of the 16th century.

The Plateau inhabitants did not pack up and leave the mesas together, on one day. The departures to and relocations in the valley probably took place over several years and could have been caused by any of several reasons — the most likely being exhaustion of the soil through poor farming methods and a drought that occurred in the upper Rio Grande Valley during the last half of the 16th century.

A second indication of post-16th century use of the Plateau by Indians is the presence of game pits. The pits probably were not in use while farming was the predominant occupation. It would have to be after the cessation of farming and after villages were abandoned that the natural plant and animal populations were once again established, and hunted and trapped.


GUAJE CANYON
RENDIJA CANYON
DIAMOND DRIVE
PUEBLO CANYON
TRINITY DRIVE
LOS ALAMOS
WEST JEMEZ ROAD
EAST JEMEZ ROAD
PAJARITO ROAD
MORTANDAD CANYON
PAJARITO CANYON
VALLE CANYON
STATE ROAD 4
ANCHO
WATER
ROTARILLO
FRIJOLES CANYON
CHAQUEHUI CANYON
▲ Excavated sites
• Unexcavated sites
④ LASL Technical Areas

10 Years Ago in Los Alamos

Culled from the
January and February
1968 Files
of The Atom
and the
Los Alamos Monitor
by
Robert Y. Porton

RATES GO UP

Post office officials announced this week that increased postage rates will go into effect Sunday. The new rates are 6 cents for first-class mail and 10 cents for airmail. The new rate of 6 cents per ounce for first-class mail applies up to 13 ounces.

HERDING HORSES HURTS

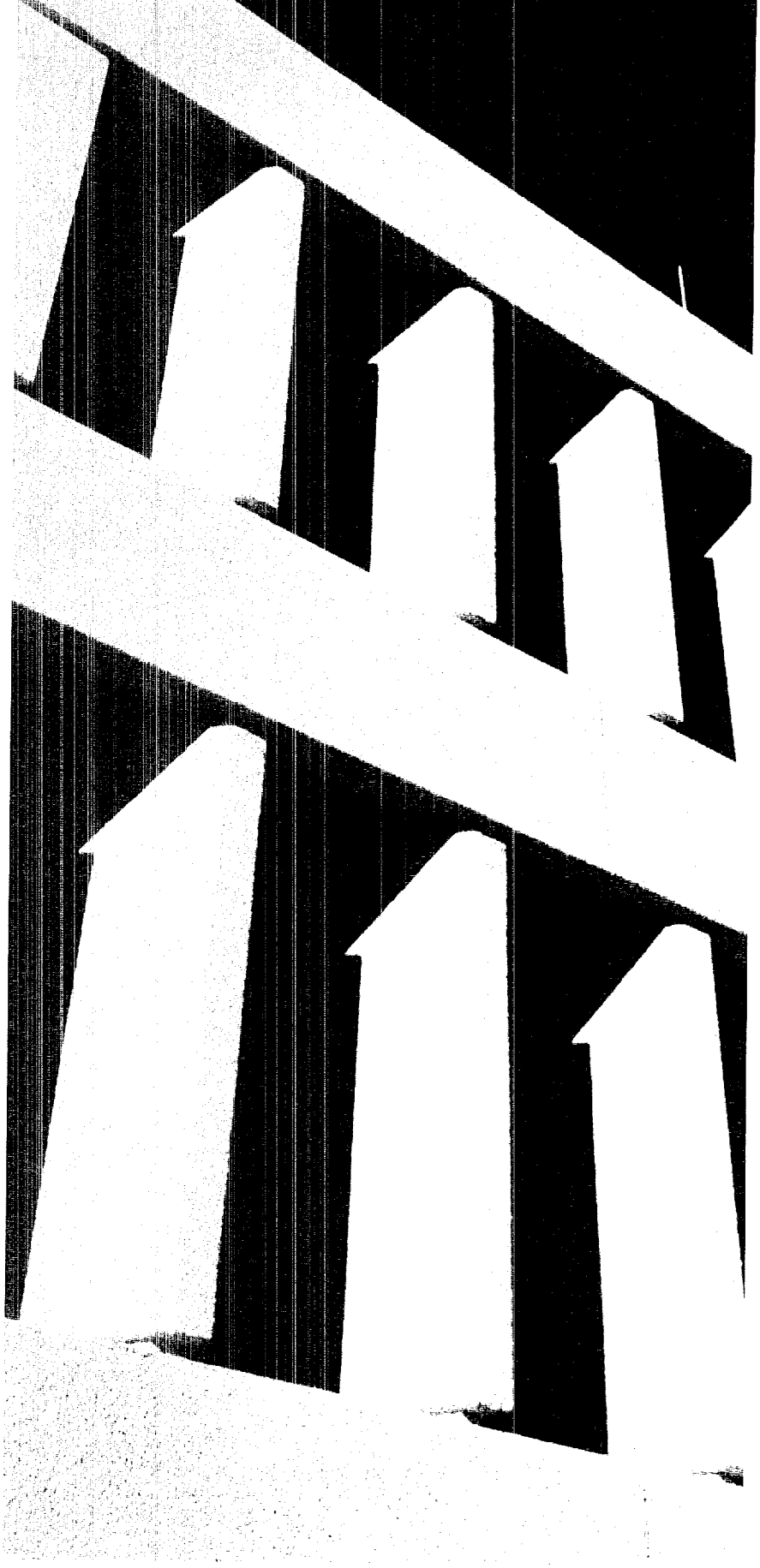
Some of the services performed by Los Alamos police are rather unusual. Two patrol cars were dispatched to Barranca Mesa Friday when 10 horses and mules were reported running at large. They were Forest Service animals, apparently escaped from the corral near Pine Springs. The 2 officers herded the animals down into Rendija Canyon, attempting to get them on their way back to the corral. One mule expressed its feelings about the whole thing, reared up, and kicked 1 of the police cars. There were no arrests.

GROUND BREAKING

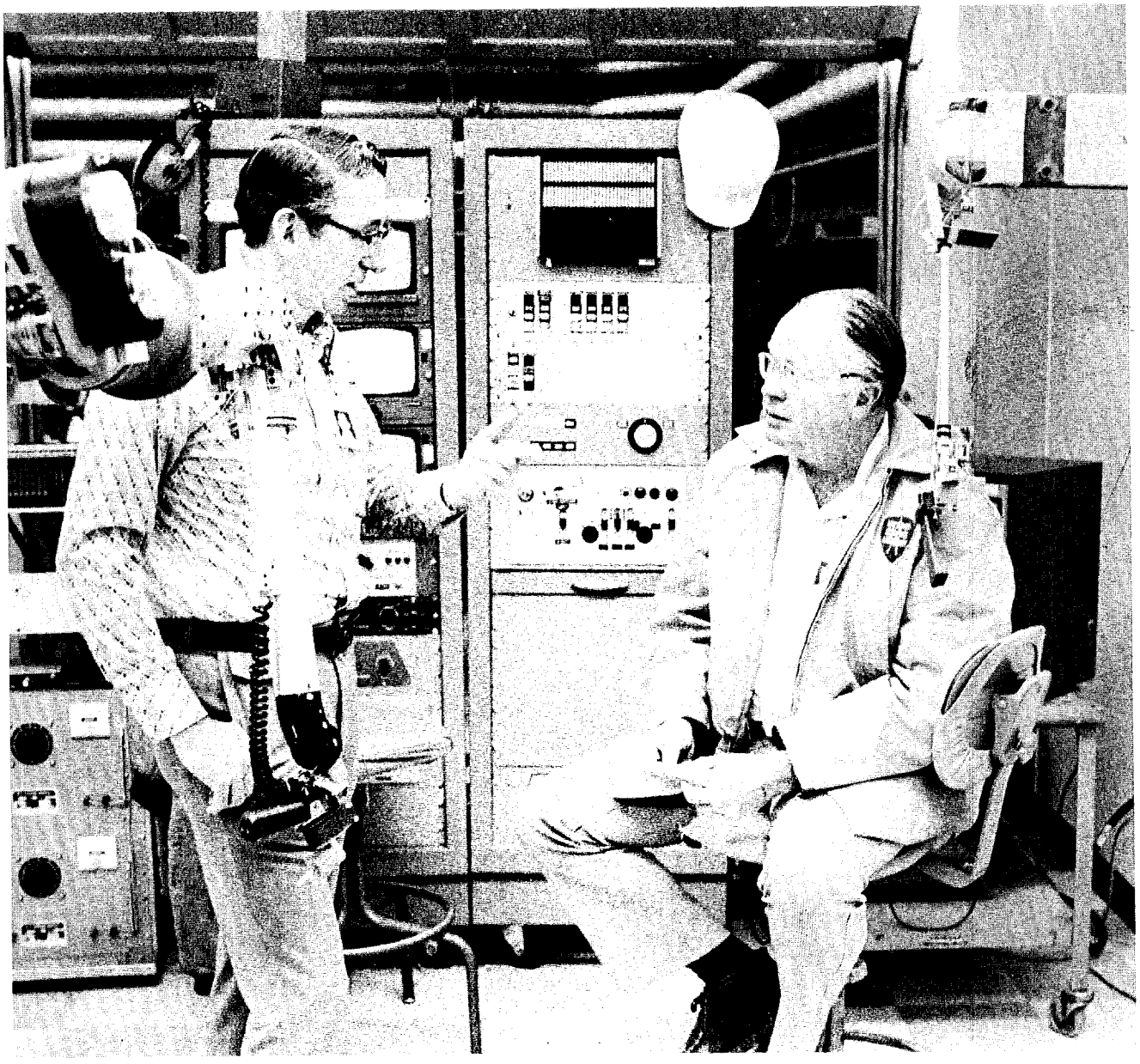
Ground breaking ceremonies for the new LASL Meson Facility were held yesterday in the Administration Building Auditorium. Because of a heavy snowfall and extreme cold weather, soil from the site was hauled to the auditorium, and symbolic ceremonies were held indoors where the sand was encased in hugh wooden containers. In addition to the dedication of the Meson facility, the Laboratory celebrated its 25th anniversary. Speeches were given by Glenn T. Seaborg, chairman of the U.S. Atomic Energy Commission, New Mexico Senator Clinton P. Anderson, and other dignitaries.

GOOD OLD DAYS

Advertisement by a Los Alamos service station: GAS WAR - Regular - 27.9 cents a gallon!



Strong sunlight creates deep shadows on the side of the National Security and Resources Study Center. The photo is by Bill Jack Rodgers.



Ethen Ekberg, left, and Don Grisham, both MP-7, are involved in the use of slave labor at LAMPF. Barb Mulkin's story, and more photos by Bill Jack Rodgers are on page 14.